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# (54) Electrostatic spray gun

(57) The invention concerns an electrostatic paint spray gun which atomises the paint material by means of a rotary bell 10. The bell 10 is rotated by the reaction of outflowing air jets which flow from the hub 24 or the outer surface of the bell through nozzles 31, 37 arranged there at an angle to the rotational axis of the bell. The compressed air introduced into the ball via a line 9 provides an air bearing for the bell. The air flows from the nozzles towards an atomization edge 36 of the bell to atomise paint fed from a conduit 17.

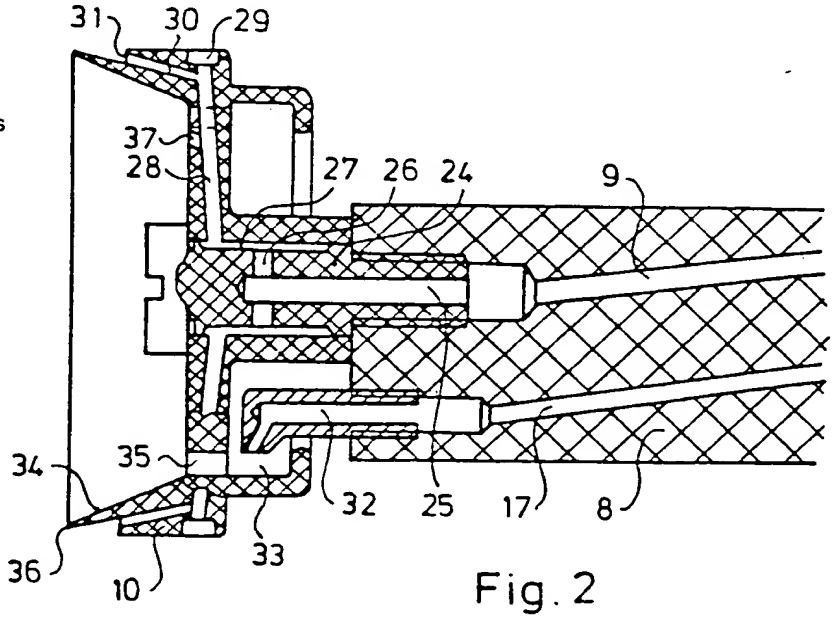


Fig. 2

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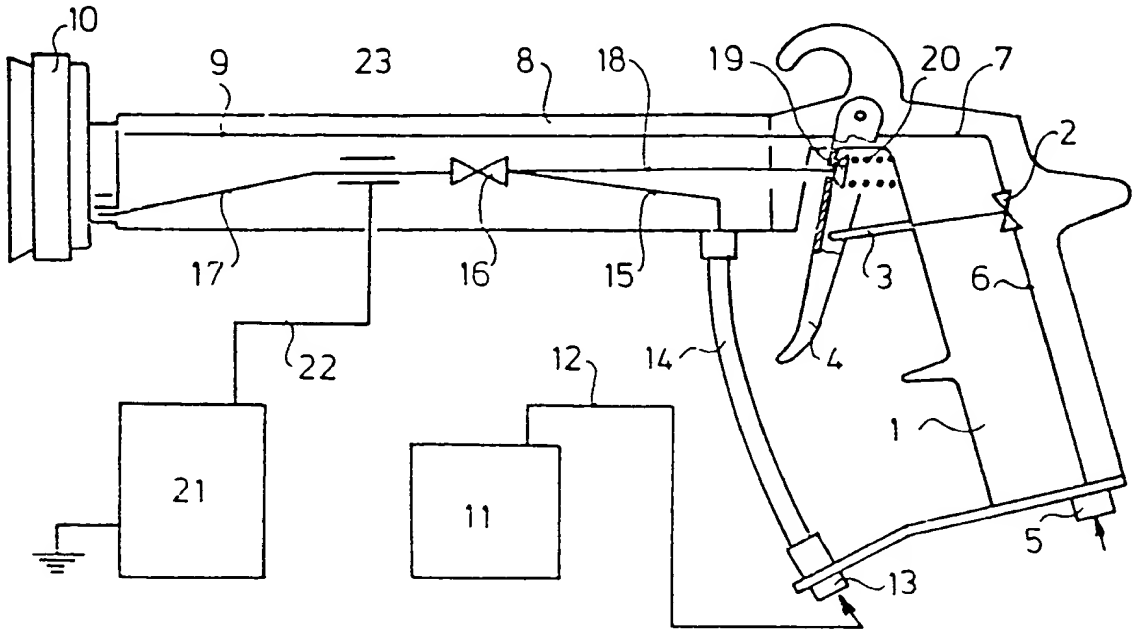


Fig.1

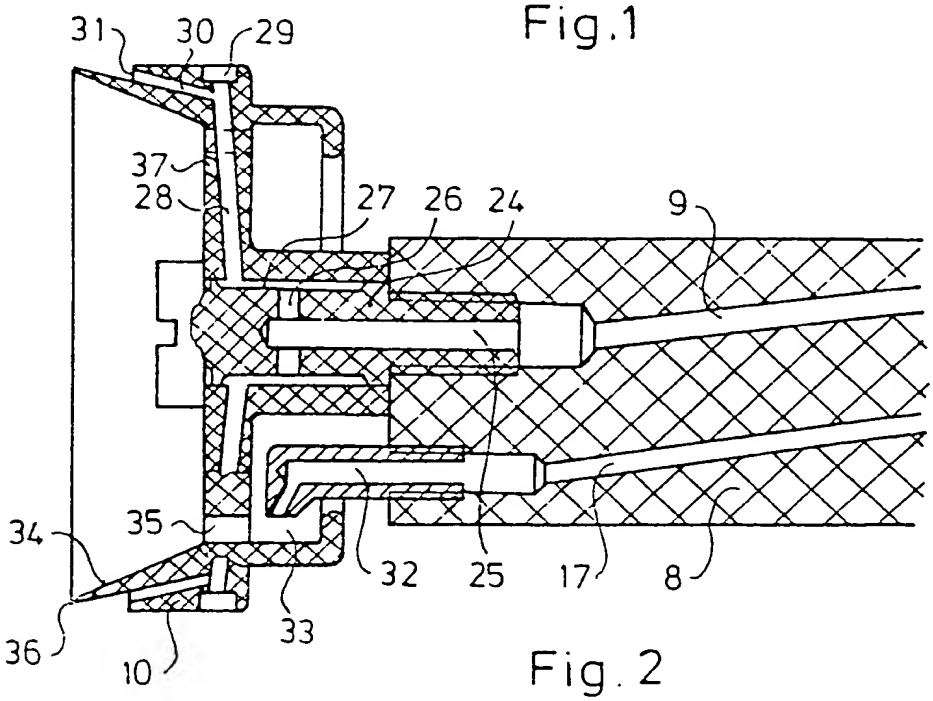


Fig. 2

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SPECIFICATION

## Electrostatic spray gun

The invention concerns an electrostatic spray gun which has an atomisation device with a rotary bell rotated under the action of an air stream, the air stream being in the form of jets flowing out of nozzles suitably arranged on the hub or on the outer surface of the bell and at an angle to the axis of rotation; the air jets directed at the atomisation edge improve the efficiency of atomisation and at the same time the air rotating the bell and supplied via the axis provides an air cushion in the bearing of the bell in order to 'lubricate' the bearing.

It is a well-known fact that rotary atomisers represent one of the most efficient electrostatic spray devices wherein the liquid or pulverulent (hereafter: paint) material is atomised predominantly with the aid of electric forces. In this case the velocity of the paint material mist is low so that it is readily attracted to the object to be coated. For this reason only a small amount of paint material is sprayed past the object, i.e. the efficiency of the application of paint is extremely good.

As against this, however, the rotary bell serving for spraying and atomisation must be driven by some sort of mechanical method; the most varied embodiments are known for this purpose, thus, e.g. electric motors, air motors and a drive by means of turbine blades or impeller vanes.

At the same time, the bell is connected to a high voltage of 60–100 kV; hence it is most important that the rotary bell should be adequately insulated against earthed metal components, e.g. the drive motor. Additionally, the drive of the bell in the case of an electric motor drive employs a rather long insulating shaft, as is the case in the French apparatus SAMES or the Hungarian device HANDSPRAY.

When the drive is with compressed air, the problems associated with insulation can be solved more easily because the medium carrying the energy, i.e. the air, is itself insulating.

Two methods are known for driving the bell with compressed air. In the first one, blades or vanes radially projecting from the cylindrical rotor of the motor rotate in an eccentric housing. In the other system one or more air jets flowing out of one or more nozzles are directed to a blade ring where the torque required for rotation is produced on the basis of the kinetic energy of the air jet or the pressure difference across the blades. An apparatus of this type is described in HU-PS 154,524 wherein the impeller wheel is blown at by means of a row of bores arranged in a circle in the rotary bell itself.

Rotational systems actuated by compressed air, particularly the last-mentioned, are all very sensitive to the resistance of the rotation systems. When, for instance, the torque required for rotation increases for whatever reason, the r.p.m. falls sharply. Such a case can come about for numerous reasons, most frequently when the quantity of paint material introduced into the bell for atomisation changes. The paint material flows along the inner surface of the bell whereby the Coriolis force generated brakes the bell. With increasing quantity of paint the Coriolis force also increases, whereby the torque or the braking of the bell also increases and the r.p.m. drops.

As long as the bells were rotated with a low r.p.m. of 600–3000 U/min, the importance of this phenomenon was negligible. However, lately systems have appeared with bells rotating at high r.p.m., 10,000–40,000 U/min, in which the centrifugal force also plays an important role in the atomisation of the paint material. In this case, a significant change of r.p.m. is undesirable because this causes an appreciable change in the annular spray pattern. For bells rotating at a high r.p.m. the Coriolis force exerted on the paint material flowing on the inner surface of the bell is also greater, the r.p.m. increases to a greater extent, whereby in addition to the change in the size of the spray annulus also the efficiency of atomisation becomes lower. The torque required for rotation may also increase for other reasons, thus for instance when the system is contaminated, whereby the friction increases.

In order to avoid the above-mentioned drawbacks, electronic control units have been developed, which measure the r.p.m. of the bell and when it drops the quantity or the pressure of the driving air is increased to restore the r.p.m. of the bell to an approximately constant value. Such systems are, however, sensitive and costly and their operation and maintenance require high technical skills.

The aim of the invention is to avoid the above-mentioned disadvantages and to develop an electrostatic spray gun in which the r.p.m. of the rotary bell may be altered within wide limits by changing the pressure or the quantity of the air supply without a significant change in the spray pattern.

Accordingly, the invention concerns an electrostatic spray gun provided with a rotary bell which has ducts for supplying air and paint, mechanical shut-off means and a high tension electrode for electrostatically charging the paint in the paint supply duct. The essence of the invention consists in particular in that the ends of the air supply ducts debouching into the open air are directed at the hub or on the inner surface of the rotary bell obliquely to the axis of rotation of the rotary bell and the outlets of the air ducts are directed towards the atomising edge of the rotary bell.

According to an advantageous embodiment of the invention the air duct to the rotary bell is led through the rotary axis and the bearing

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gap of the rotary bell in order to lubricate the bearing of the rotary bell by the formation of an air cushion.

The atomisation effect of the spray gun according to the invention and the diameter of the annular spray pattern are influenced by three factors, namely the electrostatic force, the centrifugal force and the mechanical deflection effect of the air jets directed to the edge of the bell. When the quantity of the paint material flowing through the bell is increased, the velocity of rotation increases with the increasing Coriolis force. The relative velocity of the air streaming out of the nozzles also increases, however, since the reaction to overcome the higher resistance torque requires a higher reaction; since the air is now flowing at a higher velocity to the atomisation edge, it equalises or compensates the worsening of the atomisation effect due to the reduction in the centrifugal force.

When in contrast the r.p.m. of the bell is increased by the supply of a greater amount of air, the diameter of the annular spray pattern tends to increase with the increasing centrifugal force. However, the high velocity of the air flowing out of the ducts directed to the atomisation edge of the bell nevertheless steers the spray pattern parallel to the axis, whereby the above-mentioned effect is compensated, the spray pattern once again takes up its orignal diameter.

The invention is described by way of an advantageous preferred embodiment with the aid of the accompanying drawing, in which:

*Figure 1* is a schematic diagram of an electrostatic spray gun according to the invention, and

*Figure 2* is a section on an enlarged scale of the rotary bell and the front part of the rest of the apparatus.

As may be seen from Fig. 1, a metallic handle 1 contains an air valve 2 which may be opened by a rod 3 actuatable by a trigger 4. Compressed air passes via a junction 5 into a duct 6 formed in the handle and flows, when the valve 2 allows, via a duct 7 disposed in an insulating body 8 to an atomisation bell 10.

The paint material to be sprayed out passes from a container 11 via a hose 12 to a supply junction 13 and from there over a short hose 14 and a duct 15 to a paint valve 16 present in the insulating body 8. From there the paint is delivered to the bell 18 via a duct 17. By the intermediation of an insulating rod 18 the actuating trigger 4 opens the paint valve 16 via a plate spring 19 against the biasing force of a spring 20.

The high voltage required for electrically charging the paint material is provided by a high tension generator 21 connected via a high tension cable 22 to a metal electrode 23 mounted in the paint supply duct 17.

The duct 9 in the insulating body 8 delivers the compressed air into a bore 25 (Fig. 2) of a hub 24 which journals the bell 10. The pressure force passes from the bore 25 via radial bores 26 into the bearing gap 27 between the hub 24 and the hub of the bell 10. The bell 10 is made of plastics material and rotates on the air cushion formed here. The air now passes from the bearing gap 27 via bores 28 formed in the bell 10 into inner and outer nozzle jets 37 and 30 respectively, which jets are obliquely formed (in plan view) respectively in the bottom and outer surface of the bell and are directed obliquely to the axis of rotation of the bell 10.

The locking bodies 29 are provided only for manufacturing reasons.

The air jets flowing out of the bores 30, 37 in an inclined direction produce, on the one hand, the torque required for rotating the bell and, on the other hand, favourably influence the atomisation of the paint material flowing along the internal surface 34 of the bell, because they are blown along that internal surface 34 and the outer surface of the bell body to the circular spray edge 36.

The paint passes over the duct 17 and the outlet pipes 32 to an annular distribution chamber 33 formed at the back of the rotary bell, and flows through openings 35 in the bottom of the bell along the inside 34 of the body to the atomisation/spray edge 36.

CLAIMS

1. Electrostatic spray gun, comprising a rotary bell, ducts for respectively conveying compressed air and a liquid or flowable coating material, mechanical blocking means and a high tension electrode arranged in the material supply duct for electrostatically charging the material, wherein the outlet end of the air supply duct is formed with a plurality of nozzles debouching into the open air, the nozzles being arranged in the floor and/or the outer surface of the rotary bell obliquely relatively to the axis of rotation of the bell and are directed generally towards the atomisation edge of the bell.

2. Electrostatic spray gun according to claim 1, wherein the air duct is passed to the rotary bell through the axis of rotation of the latter through a bearing gap in order to lubricate the bearing of the rotary bell by the formation of an air cushion.

3. Electrostatic spray gun substantially as herein described with reference to and as shown in the accompanying drawing.

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